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STATE OF ART AND PROBLEMS OF THE ANIMAL FEED PRODUCTION INDUSTRY IN ZAMBIA

Information paper*

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CONTENTS

		Paragraphs	Page
I.	Introduction	1 - 5	3
II.	The animal feed production industry - past and present	6 - 10	4
III.	Sources of raw materials	11 - 29	5
	- Energy sources	15 - 19	5
	- Protein feeds	20 - 24	6
	- Soya bean cake	25 - 26	7
	- Sunflower	27	7
	- Cottonseed cake	28	7
	- Mineral sources	29	7
IV.	General description of the existing technologies for animal feed production	30 - 31	8
V.	Present constraints affecting animal feed production in Zambia	32 - 37	8
	- Technical factors		10
	- Availability of feed ingredients		10
	- Quality of feed produced		10
	- Localization		11
	- Pricing policy and price increases of raw materials and stock feeds		11
	- Quality control		11
	- Institutional support		11
VI.	Recommendations	38 - 48	11
VII.	Conclusions	49	13
	References		14

Tables

Table 1:	National stock feed production, 1980-1991.	16
Table 2:	National oil cake requirement and production for 1989/90 period	17
Table 3:	Estimates of livestock population in Zambia	18
Table 4:	Crops produced and marketed (1988)	19

Figures

Figure 1:	*Per caput* production and consumption of all meat 1972-85	20
Figure 2:	*Per caput* production and consumption of cow's milk 1972-85	20

I. INTRODUCTION

1. Zambia's human population grew by about 3.2% a year over the past two decades, but the amount of food it produced only increased slightly. Therefore, each person in Zambia on average has less food now than 20 years ago. The food situation is worse this year because of the severe drought that affected the whole of the southern African region. The outlook is even grimmer for the supply of food-related livestock products. The annual stock for sale this year rose sharply, outstripping the herd and flock growths as people sold their animals and poultry for fear of them dying due to lack of food and water as result of the drought. The current levels of saleable animals stock are thus unsustainable unless these can be re-stocked and flock/herd productivity increased.

2. Livestock plays a variety of economic and social roles in Zambia. They provide high quality food outputs (milk, meat and eggs) for consumption at home or sale in the market place, inputs into crop production (manure, draught power), transport and household fuel supplies, and other non-food outputs (hides, skins and fibres for making a variety of household products). Sales of livestock and their products raise cash for their owners to buy what they cannot produce themselves, such as fertilizers and seeds needed to increase crop production. Because livestock grow in number and in individual size, they also constitute a form of investment and security in which savings can be kept and drawn on in time of need. In some societies of Zambia, livestock ownership also provides prestige. Therefore, Zambia's livestock subsector is important.

3. The most valuable output of livestock is meat, accounting for 47% of the total value of all food-related livestock products, while milk is value at 14% (International Livestock Center for Africa, ILCA, 1990). People in sub-Saharan Africa eat little meat - an average of about 10 kilograms per person per year, compared with over 80 kilograms per person per year in Europe (ILCA, 1990). In general, this reflects the small amount of meat produced in the region. Between 1974-76 and 1986-88, per capita meat production in Africa declined by 0.7% per year, while consumption increased by only 0.1% per year (ILCA, 1990). In the mid 1970s, when livestock feed production and quality were at a peak in Zambia, the average consumption of marketed meat was about 8 kilogram per person per year (Liteta and Ngulube, 1991), a figure lower than the average for the sub-Saharan African region. Poultry accounted for about 48% of this. Between 1976 and the early 1980s, poultry production, which was the best performing section of the livestock subsector, declined at a rate of about 4% per annum (Liteta and Ngulube, 1991), leading to an even lower meat consumption per person per year. Present egg production represents 39 eggs per person per year (Liteta Ngulube, 1991). This shortage of animal protein in people's diets leads to malnutrition and consequently predisposes children to increased susceptibility to disease, slow growth, mental retardation and sometimes death. Schlesinger and Stekel (1973) observed that the whole immunological mechanism is altered after a prolonged period of malnutrition.

4. Livestock could play a much more important role in increasing Zambia's home grown food supplies and the provision of high quality protein to combat the existing calorie/protein imbalances in people's diets, but the livestock subsector is plagued by technical, social, economic and institutional problems. Among the more serious technical constraints is poor nutrition, which is commonly regarded as the main limitation to livestock performance in sub-Saharan Africa (ILCA, 1991), and central to this are inadequate and erratic supplies of good quality (digestibility and protein content) animal feeds.

5. This paper examines the state of art of the animal feed production industry in Zambia. The major constraints affecting the industry's performance are highlighted and recommendations on how these can be overcome are suggested.

II. THE ANIMAL FEED PRODUCTION INDUSTRY - PAST AND PRESENT

6. The total animal feed market in Zambia is estimated at 140,000 tons (Lee, 1991); with the poultry sector being the major compound feed user (about 80% of the feeds produced), followed by the pig sector (12%), and the cattle sector (6%). The product categories include broiler (starter and finisher), chick, growers, layers and breeders mash for poultry; pig creep, pig grower and sow meal for pigs; calf and dairy meal for dairy cattle. The feed for dairy cattle cannot all be classified as compound feed as much of it are simple mixtures without premixes added. Similarly, beef cattle feeds cannot be classified as compound feeds although a compound feed, high energy beef meal, used to be made in the 60s through the mid-80s. Others include horse feeds, laboratory animal feeds (e.g. mouse comproids) and rabbit pellets. Turkey feeds and other types of poultry feed may be produced on request.

7. Up to the late 1980s, about 70% of the stock feeds produced and marketed in Zambia were produced by a parastatal corporation's (Industrial Development Corporation, INDECO) subsidiaries: National Milling Company Ltd. (NMC), Indeco Milling Ltd. (IML), and E.C. Milling Ltd. (ECM), now Amalgamated Millers, (AML). The remaining 30% was produced mainly by the Zambia Agricultural and Trading Company Ltd., Jamas Milling Company, Chimanga Changa Ltd., and Kabwe Milling, all parastatal companies. The parastatals' monopoly of the stock feed market ended in 1989/1990 with the entry into the business by two private companies: Nshima Milling and Soy Nutrients. Some farmers and private poultry breeding companies mix stock feeds for their own use and their contribution to the total stock feed production is estimated to be about 30%.

8. Most of the stock feed producing plants in Zambia are located along railway lines thus most of the livestock farming, especially poultry, is confined to the Lusaka, Central, Copperbelt and Southern provinces, which are served by the railway line. The confinement of stock feed production plants to the four provinces leaves great potential for growth in livestock production yet to be exploited in the remaining five provinces of the country if stock feeds could be made available there.

9. Stock feed production in Zambia was a flourishing industry in the 1960s and 70s. This was mainly because the country had enough foreign exchange to import sufficient quantities of animal and vegetable proteins and other ingredients for use in the compounding of animal feeds. As such, 90% of the protein ingredients and all of the vitamins and minerals were imported. Because the imported ingredients were of good quality, the quality of the stock feeds produced was high. The other reasons the stock feed industry did well are that the plants and machinery were fairly new and in sound shape, and that the costs of raw materials and other production inputs such as energy, transport and other production overheads were fairly predictable (Chacko, 1990).

10. Over the last decade the situation has changed for the worse. There is no foreign exchange to import sufficient quality raw materials, stock feeds are produced in old plants whose output capacity has been greatly reduced (most plants operate at below 50% capacity utilization, Musenge, 1990), and the industry depends largely on locally-produced vegetable proteins such as

soya beans, sunflower and cottonseed cake which are not only available in insufficient quantities, but are also of poor quality. Table 1 highlights the trend in stock feed production since 1980.

III. SOURCES OF RAW MATERIALS

11. Supply of, and demand for stock feeds change depending on the quality, quantity, price and distribution of the stock feeds on one hand and livestock on the other. The two areas are interdependent in such a way that if one area suffers the other gets affected as well. As the trend in stock feed production for the past decade indicates (table 1), the drop in stock feed production from levels of about 192,000 tons to about 140,000 tons per year imply that some livestock farms, especially poultry, were closed completely or there were cut-backs in the herd or flock sizes to adjust to the stock feed supply situation.

12. Many farmers have in the past purchased feeds on the basis of price per ton, and many still do. This has in fact in the past often been the right procedure in order to obtain the maximum profit because the quality of the feed was high. Today the situation is quite changed. The emphasis is now on quality as this fluctuates greatly depending on the availability of good quality raw materials. There is ample evidence that maximum profit is obtained by the use of high quality feeds. Purchase of livestock feeds on the basis solely of price per ton is now an obsolete method of training (Lee, 1991). Zambia is fortunate in that it has the potential to be self-sufficient in supplying the main feed ingredients and only needs to import specialized additives such as premixes and drugs. This means that potentially over 90% of the feed cost is local component which is highly favourable for livestock development in the country.

13. Feed ingredients used in formulation of stock feeds are classified into four major categories:

(i) Energy sources
(ii) Protein sources
(iii) Minerals and vitamins
(iv) Additives.

14. The major ingredients that constrain feed compounding are the energy and protein sources.

Energy sources

15. Maize, millet, sorghum, barley and oats are the major cereal grains used in animal feed production. Occasionally, surplus or damaged wheat, if lowly priced to compete with these coarse cereals, is used in poultry rations. In some cases broken rice is included in animal feed rations.

16. In Zambia, maize and its by-products comprise the main source of energy feeds. A total of 90,000 - 100,000 tons of maize and its by-products is required annually by the stock feed industry. The allocation of maize for stock feeds is secondary to the needs for human consumption as maize (white) is also the staple food in Zambia. Therefore, yellow maize would be preferred for stock feed production. However, very little yellow maize is grown in the country. For instance, in 1989/90 season the three stock feed plants under INDECO could procure only about 5,000 tons of yellow maize against the total of 30,000 tons it required.

17. Sorghum, millet and cassava are crops grown in the country that can be used as energy sources in stock feeds, but these, though produced in amounts large enough for them to be used in commercial quantities for stock feed production, are retained by farmers for use in the homes (see table 4), mostly for brewing local beer for sale.

18. Maize No. 3 meal is the by-product produced during the manufacture of breakfast meal. Up to 45,000 tons may be produced and this is enough to meet the country's annual requirement for this product for stock feed production.

19. Maize and wheat bran, because of their high fibre content, are of limited use for poultry feeds and thus are available in excess. These are extensively used by cattle farmers.

Protein feeds

20. Protein feeds used in the compounding of stock feeds include animal and plant proteins. Animal protein sources include fish meal, meat meal, meat and bone meal, blood meal and chicken offal meal. Only minimal amounts of animal proteins are available in Zambia. Vegetable protein in the form of oil cakes is the main source of protein. Soya bean meal, cottonseed meal and groundnut meal represent the major plant protein supplements used in stock feeds. Other plant protein supplements are decorticated safflower seed meal, sesame seed meal, sunflower meal and coconut oil meal. In Zambia, the available plant proteins are soya bean meal, cottonseed meal and sunflower seed meal. These are either solvent extracted or mechanically expelled. The preference is for solvent extracted as this represents cakes of high quality in both protein and fibre content and the process easily gets rid of anti-nutritional factors present in some.

21. Plant proteins however are generally deficient in methionine and lysine and this limits their use especially in poultry diets (Scott et al., 1976). The essential amino acids of soya bean meal and maize proteins complement each other but for sulphur amino acids and lysine. These deficiencies can be rectified by supplementing with crystalline amino acids.

22. Oil seed meals or cakes available in Zambia for producing stock feeds are the by-products of oil extraction or dry extrusion processes. Oil extraction methods employed come under two categories:

(a) Solvent extraction, with or without decortication (soya bean, sunflower and cotton seeds);

(b) Mechanical extraction, with or without decortication (soya bean, sunflower and cotton seeds).

23. Dry extrusion is used for soya bean processing in order to produce full fat soya. In this method oil is not extracted.

24. The stock feed industry's requirement for oil cakes and the production of oil seeds for the 1989/90 season are given in table 2. From this table, it is evident that only cottonseed cake is produced in sufficient quantities to meet its requirement for commercial stock feed production.

Soya bean cake

25. The stock feed industry prefers solvent extracted soya bean cake because of its high quality. Processing of full fat soya for stock feeds is quite delicate. Undercooking results in a product with high levels of anti-nutritional factors such as trypsin inhibitors and overcooking reduces protein availability. Full fat soya, due to its high oil content, has a short shelf life whereas soya bean cake processed by solvent extraction stays unspoiled for months. Solvent extracted soya bean cake has an average protein content of 44%, while the meal produced by the expeller method has an average protein content of 40%, and full fat soya, 37%.

26. The present production of solvent extracted soya bean cake is only one half of the total soya bean processed in Zambia and it only forms one third of the national requirement for soya bean cake (table 2). There is only one company (Premium Oil Industries, located in Lusaka) with a solvent extraction facility in the whole country. Its processing capacity for soya beans is about 60,000 tons per annum, a capacity adequate to meet the national requirement for this product, but not enough soya bean is grown in the country to meet the plant capacity. For instance, in the 1989/90 season, the plant could achieve only one fourth of its capacity. This situation therefore makes it very difficult for the animal feed industry to consistently produce high quality stock feeds.

Sunflower

27. The minimum protein level in sunflower cake stipulated by the Zambia Bureau of Standards for the lowest grade sunflower cake is 25%. However, the sunflower cake produced by the oil processing companies at best is about 26%. According to the sunflower seed processors the reason for this is that the seeds they procure from the farmers are of composite nature (of different sizes). This makes dehulling extremely difficult and results in substantial amounts of seed getting wasted along with the hulls. Because of this, the processors are reluctant to dehull the seeds and as a result the feed industry gets a very low protein quality and very high fibre (up to 40%) sunflower cake. This limits the inclusion rate of sunflower in feeds for monogastrics, especially poultry.

Cottonseed cake

28. The major constraint on the usage of cottonseed cake is its inherent gossypol content and high fibre level. It is not usually used at an inclusion higher than 3-5% in poultry and pig feeds. Considering that over 90% of stock feed produced commercially in Zambia are for poultry and pigs, the usage of cottonseed cake is highly limited.

Mineral sources

29. Sources of minerals for stock feeds are mainly salt, limestone flour for calcium, and dicalcium or monocalcium phosphate for calcium and phosphorus. Limestone flour is readily available in Zambia while salt and dicalcium or monocalcium phosphate are imported. Also imported are drugs, trace elements, vitamins and amino acid supplements.

IV. GENERAL DESCRIPTION OF THE EXISTING TECHNOLOGIES FOR ANIMAL FEED PRODUCTION

30. Stock feed producing plants that exist in Zambia today can be divided into two categories:

(a) Sophisticated or elaborate plants

These are the industrial feedmills and are mainly intended for grinding, dosing, mixing and pelleting compound feeds from cereals and oil meals, but not from roughage. The feed industry in Zambia is thus much more involved in the feeding of pigs and poultry than of ruminants.

The advantage of elaborate mills is that production is highly automated and mixing is quite precise. One company, National Milling Company, installed a computer in 1991 to improve the mixing of ingredients, particularly micronutrients, and for the production of concentrates to which farmers can add their own major ingredients such as energy sources and roughage.

(b) Simpler mill mix mills

These will consist of:

(i) Hammer mill
(ii) Platform scale
(iii) Mixer

The main equipment is the hammer mill and mixer. These are quite suited for farm mix and will easily cater for both ruminants and monogastrics.

31. It is clear that the stock feed industry in Zambia is geared essentially towards poultry and pig feed production except for a limited quantity of concentrates for cattle. However, taking into account the fact that the share of roughage in total feed resources represents about three quarters or more of the total, and that roughage constitutes 85% or more of feed intake in ruminants in developing countries (Agostini, 1985), there is a need for the feed industry to start producing complementary feeds for on-farm mixing with grain and roughage.

V. PRESENT CONSTRAINTS AFFECTING ANIMAL FEED PRODUCTION IN ZAMBIA

32. Food production per capita in sub-Saharan Africa has declined considerably during the last two decades which has resulted in a widespread food crisis and increasing dependence on food imports (FAO, 1986). Figures 1 and 2 show that production has fallen short of consumption in sub-Saharan Africa for two of the most valuable food-related livestock products, meat and milk. The productivity of livestock in this region in terms of meat and milk is said to be the lowest of any region world-wide (Gryseels, 1988). The increase in livestock output have been largely due to a numeric expansion of heads and flocks, rather than from increased yield per animal (Anteneh et al., 1988). This grim picture needs urgent attention if sub-Saharan Africa is to move away from the high import-base situation to self-sufficiency in food and be free from the almost endemic food crisis with which the sub-region has become associated. Solutions to constraints affecting animal feed production in Africa should be considered in the light of characteristics peculiar to the individual countries.

33. Zambia has a high urban population growth rate. For instance, between 1963 and 1969, the urban population was 29.4% of the total population. This rose to 35.3% by 1974 (National Commission for Development Planning, 1979) and 47% by 1983 (International Bank for Reconstruction and Development, IBRD, 1986). In the last census held in 1990 the urban population was estimated at about 55%. This rapid increase in urban population, the high annual population growth rate, the shortage of foreign exchange, and the fall in people's real incomes hence their purchasing power experienced since the mid-1980s following the devaluation of the Zambian currency, are all likely to lead to a decline in an already low animal protein consumption, worsening the existing protein deficiencies in the diets of the people, resulting in increased levels of malnutrition in the country.

34. Zambia's high urban population means that a relatively high proportion of the population is in that portion of income distribution where income gains are quickly translated into an incremental demand for livestock products. Coupled with the high population growth, it means an incremental demand of about 4% per year on meat and milk (Brumby, 1988). This high demand for livestock products calls for a very productive livestock sector. To achieve this, production should be based on a confined approach. The establishment of confined animal production systems to supply the urban centres with food-related livestock products will inevitably lead to increased demand for high quality animal feeds on a regular basis.

35. The consumer of stock feeds is the producer of livestock. In Zambia livestock producers can be broadly classified into two major sectors: the commercial sector, consisting of farmers engaged in farming activities on a large scale for the production of agricultural products for sale, and the traditional sector, consisting of small holders engaged in farming activities mainly for the provision of all or almost all the goods required by the farm household, usually without any significant surplus for sale. Table 3 shows estimates of livestock population in Zambia, dividing it into the traditional and commercial sectors. It is evident that livestock production in Zambia is dominated by traditional or subsistence farmers, owning on average 83%, 92% and 87% of the country's cattle, sheep and goats, and pigs, respectively. This means that if livestock output is to increase, animal productivity has to be improved in the traditional sector.

36. This is not an easy task as the small holders are usually located far away from urban centres, making it hard to reach them for the provision of inputs and services. Some problematic characteristics to increased animal productivity of the subsistence farmers are that they keep animals under low-input management systems, as an adjunct to crop production. Their main interest lies in the food crops on which the families depend for survival. They are usually resistant to change, new innovations and new ways of doing things. Another characteristic of these farmers is that they regard animals as assets rather than commodity. They would rather keep their animals and maintain, if not improve, their social status in their communities than sell their animals. Another characteristic is that the subsistence farmer has very low purchasing power. He would rather buy food or other essentials for himself and his family than buy feed for the livestock. The task therefore is how to penetrate the usually resource-poor small holder and convince him to use the feeds the stock feed industry produces to improve animal productivity.

37. Both technical and non-technical factors constrain livestock feed production in Zambia and these will be discussed.

(i) Technical factors

The feed industry is faced with a major problem in that despite the high demand for stock feeds, the industry cannot meet this demand mainly due to the fact that the machinery is old. The plants operate at about 50% capacity due to constant breakdowns. It is also difficult to get spare parts for machinery more than 25 years old. Expanding or overhauling the plants is not likely to be embarked upon as these parastatal companies are no longer making a profit. Such an undertaking is, in all probability, only possible through assistance from donor agencies negotiated through the government.

There is not enough storage capacity to store major ingredients such as energy and protein ingredients at plant sites. The supply, especially of protein resources, is often scarce and spasmodic. The supply of the major energy source, maize, is dependent on the surplus after the human requirement is met. These ingredients are from annual crops or by-products produced seasonally.

There is need for proper technology (e.g. for drying such products as brewers' grain) to be set up to allow for efficient use of wet agricultural or industrial by-products which could be valuable sources of proteins and/or energy in animal feeding. An example is brewers' grain from the thriving brewing industry in the vicinity of the plants, especially those in Lusaka the capital and Ndola on the Copperbelt.

There are no laboratory facilities at plant sites for testing and monitoring the quality of both raw ingredients used and feeds produced.

(ii) Availability of feed ingredients

The components of compound feeds, both imported and locally produced, are not always available at the right time. The limitations are due to:

- lack of currencies for importing ingredients. This has assumed greater importance in Zambia because of the depleted foreign exchange reserves and economic problems the country is facing;
- delays in unloading ships at harbours. This is an important factor in Zambia because of its landlocked geographic nature and the unfavourable political situation prevailing in such countries as Mozambique, Angola and South Africa whose sea ports she uses;
- insufficient quantities and/or poor quality of energy and protein ingredients produced locally.

(iii) Quality of feed produced

The quality of the feed produced is highly variable. The feed industry attributes this to variability in quality of locally-produced feeds. Inadequate supplies of ingredients and delays in shipments of ingredients at sea ports also lead to poor quality of feeds produced as feed producers adulterate feeds with lower quality feed material to keep the animal industry going while waiting for the arrival of good quality ingredients.

(iv) Localization

The feed manufacturing plants in Zambia are located on railway lines covering only four out of nine provinces. Feed plants, animals (pigs, poultry and dairy) and consumers of animal products are concentrated in or near city and town centres. Here, feed mills and intensive poultry, pig and dairy operations are able to meet a large consumer demand for animal products. On the other hand, beef and small ruminant production is dominated by small holders (see table 3) scattered over large areas away from urban centres. These are not catered for by the feed industry because of the distance involved in supplying feed, an undertaking that would increase the price of the feed; besides, the small holder is least able to afford feeds. The feed industry is geared to produce mainly feed for pigs and poultry, and is not adapted to producing feeds for ruminants that utilize abundantly available low quality roughage.

(v) Pricing policy and price increases of raw materials and stock feeds

Pricing policy used to be a problem especially between 1989 and 1991. The prices of raw materials were decontrolled while those of stock feeds remained under control. For instance, the price of maize was increased by 300% between July 1989 and July 1990. Prices of solvent extracted soya bean cake and full fat soya went up by 290% and 230% respectively, while that of sunflower cake increased by 126%. During the same period, prices of stock feeds were only allowed to go up by 140% on average. The feed manufacturers made big losses and resorted to adulterating feeds with poor quality feed materials in an effort to cut down on production costs. This affected the feed quality greatly.

In 1991 stock feed prices were liberalised, they were allowed to move in relation to the increase in costs of inputs for stock feeds production. However, the high feed prices led to reduced use of compound feeds and indeed lowered levels of animal production. The high feed prices mean that the animal products from species depending on compound feed are expensive and often beyond the reach of the majority of the people in the country.

(vi) Quality control

The Zambia Bureau of Standards has specified standards for various types of feeds, but these are difficult to implement. Feed formulators cannot carry out analysis for all raw materials, thus they tend to use data collected from Western Europe and North America which do not reflect the nutritive content of locally grown raw materials.

(vii) Institutional support

There is relatively a low level of government funding for research. There is need for support of local research into problems affecting the feed industry and the animal industry in general.

VI. RECOMMENDATIONS

38. Increases in livestock output are determined essentially by the quantity and quality of the feed available. The potential for local feed resources that can be used in compounding feed have been mentioned. It has been indicated that only minimal amounts of animal protein are available in Zambia. There is a need to increase the production of by-products of the meat processing

industry, in particular blood meal, meat and bone meal and poultry by-products meal, as these can form an important source of animal proteins. Most animals are slaughtered in make-shift slaughter shelters all over the country. To enhance blood meal, meat and bone meal, and poultry by-product meal production, efficient methods of collecting and processing these materials must be identified.

39. It has been pointed out that the production of oil cakes does not meet the requirement for stock feed production. What is needed are the necessary incentives for farmers to increase the production of oil seed crops. There is need to look at vegetable oil processing not only as a means to produce edible oil, but also to produce high quality cakes for stock feed production. This requires proper understanding of the industry and meaningful interaction and collaboration by the oil seed producers, oil seed processors and end users - stock feed manufacturers.

40. It has been mentioned that the quality of the sunflower cake produced is poor as processors do not dehull because of the composite nature of the seeds from farmers. In order to improve the situation, there is need for consorted efforts of seed producers, plant breeders, sunflower farmers and seed processors.

41. Following stock feed price decontrol, prices of stock feeds have risen sharply, mostly due to the increase in price of the major protein ingredients. These increases in prices of protein raw material sources are mainly due to the increase in the price of imported fertilizers used in the growing of these crops occasioned by devaluation of the Zambian currency. In light of this, there is need to look for alternative sources of protein as substitutes for the traditional protein sources. Research in this direction has been initiated at the University of Zambia. Seed cake from Ricinodendron rautanenii shinz, a tree growing in the wild, was included in the feed formulations for broilers, replacing soya bean completely. Broilers were raised on diets containing this cake and their performance compared well with that of birds raised on soya bean meal diets (Daura and Matauko, unpublished). The crude protein content of the cake (40%) and amino acid profile indicate that it compares well with soya bean cake. There is need for support for such research especially from the feed industry, as it stands to gain from such research.

42. For the improvement of the quantity and quality of stock feeds it is necessary to embark on plant rehabilitation of the stock feed plants. The quality control measures should be strengthened by modern laboratory and quality assurance systems at plant sites.

43. There is a need to open stock feed depots in areas of the country where stock feeds are not available at present. A cheaper way would be to produce concentrates that could be transported to these depots for reconstituting with energy feed ingredients rather than transporting compound feeds.

44. It is necessary for the feed industry to adapt to reality and to increase production of feeds for ruminants. This should include concentrate that would increase the efficiency of utilization of the abundant low quality roughage.

45. There are local feed resources that are grown in the country but not widely used in animal feed compounding. Sorghum, millet and cassava are some of the crops. Marketing agencies such as co-operative unions whose business it is to buy crops from farmers should buy these crops to encourage their production. They could be used to produce stock feeds which would reduce the

dependence on maize, reducing the competition between people and animals for maize grain, improving food security of the country.

46. By-products of the citrus industry are known to be good sources of energy for cattle, small ruminants and even monogastrics (Ammerman et al., 1963. Devendra, 1973). The citrus industry in Zambia produces quite substantial amounts of pulp which can be used for this purpose (Aregheore and Chimwano, 1992). Other by-products whose use in animal feed production should be explored include brewers' grains from the brewing industry and waste from opaque beer brewing.

47. To increase animal productivity in the traditional sector the strategy should, in the first place, be oriented to the immediate improvement of on-going farm operations and, in the long run, to the incorporation of these farms into the market system. Development plans must take into account the diversity of species of livestock on these farms. Appropriate packages for the different species must, therefore, be developed. These packages for small holder livestock producers should include feeding, health and hygiene and should be of a relatively small nature, because owing to the low income level of these farmers which would not justify large investments.

48. Since the main interest of small holders is to produce crops on which the families can depend for survival, integration of crop and livestock production should be encouraged. The wealthier farmers in small holder communities prove to be those with the greatest number of animals. The causal chain in this progression to greater wealth starts with modest management changes that increase the farm income from livestock sales, thereby enabling more fertilizer to be purchased to increase grain output. The incremental crop residues then sustain greater numbers of more productive livestock. It should be borne in mind that improvements in livestock output lead to an upward trend in the productivity and income of small farmers (Brumby, 1988). The stock feed producer can help by making concentrates that will improve the utilization of the abundant crop residues and natural forages.

VII. CONCLUSIONS

49. Zambia has the potential to be self-sufficient in supplying the main feed ingredients, and only needs to import specialized additives and medicants. This means that potentially over 90% of the feed cost is local component which is favourable for livestock development in the country. There is, however, a need to produce more animal protein sources and improve the production of high quality plant protein sources. Efforts should be directed towards finding cheaper substitutes for the more expensive protein sources. There is high potential in using locally-produced feed resources such as sorghum, millet and cassava in feed compounding which are currently not used by the feed industry. Increased use of these will release maize, the staple food, for human consumption, improving the food security of the country. Price increases of raw materials, stock feeds and animal products as well as the availability of raw materials are the major constraints in livestock feed production. Encouraging the small holder who dominates animal ownership in Zambia to improve his productivity will lead to an expanded market for stock feeds.

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Table 1 National stockfeed production, 1980-1991 ('000 MT)

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990 *	1991 *
Output	192	179	147	145	136	144	146	140	130	160	140	140

Sources: DANIDA Feasibility study on rehabilitation of maize and feed mills in Zambia, 1989.

* Lee (1991). Booker Tate Ltd.

Table 2 National Oil Cake requirement and production for 1989/90 period.

Oil cake	Requirement (MT/year)	Quantity Produced (MT)	Excess/(Deficit) (MT)
1. Soyabean cake			
a) solvent extracted	36,8000	12,400	
b) mechanical extraction		900	
c) full fat soya (extrusion)		10,000	
Subtotal		23,300	
Deficit			(13,500)
2. Sunflower cake			
a) solvent extracted	9,600	3,200	
b) mechanical extraction		5,000	
Subtotal		8,200	
Deficit			(1,400)
3. Cottonseed cake*			
a) mechanical extraction	4,800	7,000	
Excess			2,200
Total	51,200	38,500	
Deficit			(12,700)

Source: Chacko, 1990. A review of stockfeed industry in Zambia.

* Cottonseed cake is used extensively by cattle farmers for mixing in the feeds for their animals, and quantities thus bought by cattle farmers are not included in the national requirement for cottonseed cake.

Table 3. Estimates of Livestock population in Zambia ('000 held)

Year		Cattle			Sheep & Goats			Pigs		
		Commercial	Traditional	Total	Commercial	Traditional	Total	Commerical	Traditional	Total
1985		393	2077	2470	32	424	456	22	156	178
	% of total	15.9	84.1		7.0	93.0		12.4	87.6	
1986		413	2107	2520	35	454	489	24	163	187
	% of total	16.4	83.6		7.2	92.8		12.8	87.2	
1987		433	2167	2600	40	485	525	26	170	196
	% of total	16.7	83.3		7.6	92.4		13.3	86.7	
1988		455	2229	2684	43	520	563	28	179	207
	% of total	17.0	83.0		7.6	92.4		13.5	86.5	

Source: Zambia, Ministry of Agriculture and Co-operatives, Planning Division, Statistics Section, 1988.

Table 4. Crops Produced and Marketed 1988 (MT)

	Produced	Marketed	Retained
Maize	1.9	1.3 Million	.6 million
Sorghum	23,000	3,000	20,000
Millet	27,000	500	26,500
Soybean	21,600	19,700	1,900
Sunflower	18,400	17,200	1,200
Seed Cotton	58,500	58,500	0
Ground nut	33,400	32,800	600

Source: Zambia, Ministry of Agriculture and Co-operatives, Planning Division, Statistics Section, 1988.

Figure 1. Per caput production and consumption of all meat, 1972-85

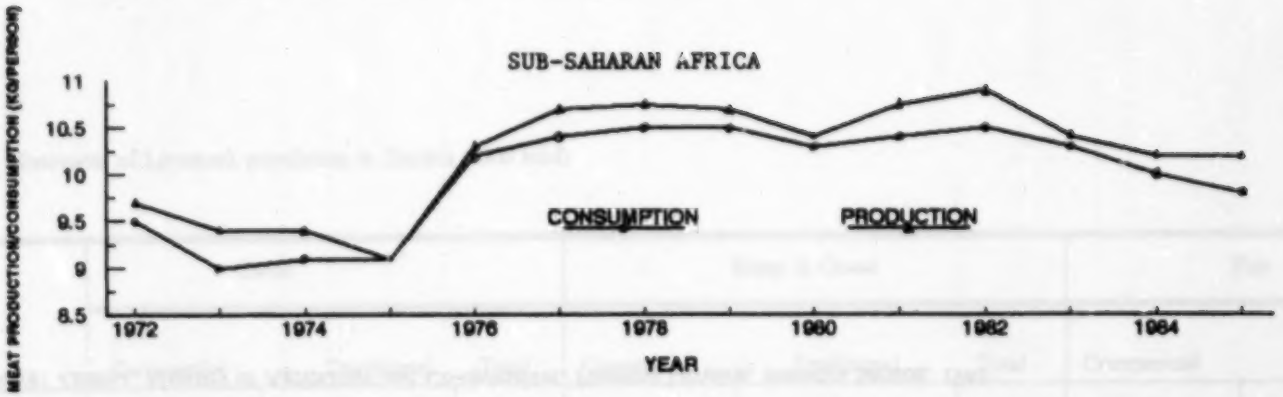
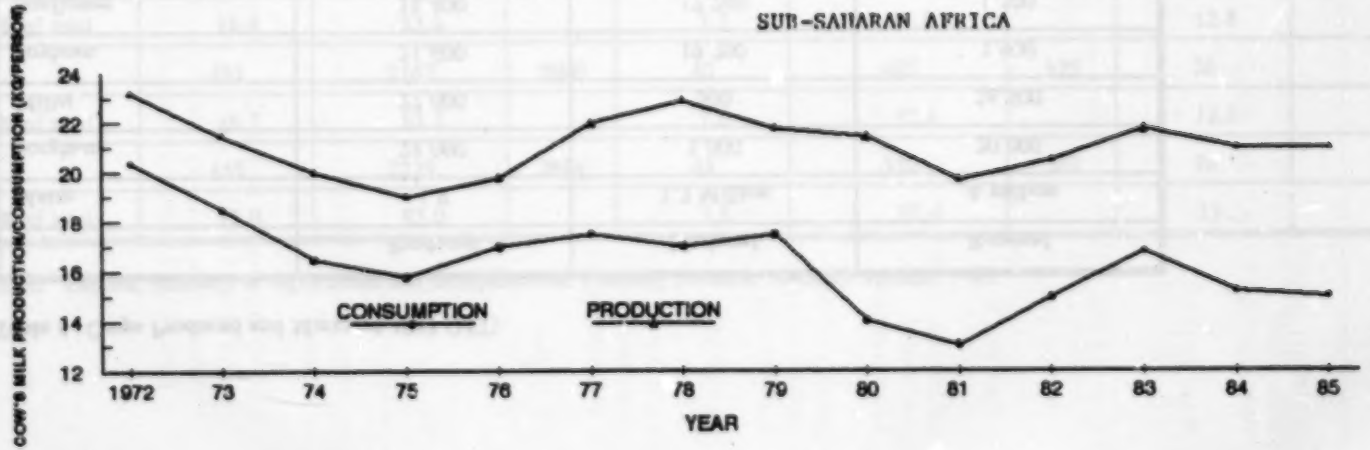


Figure 2. Per caput production and consumption of cow's milk, 1972-85



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